Figure 1

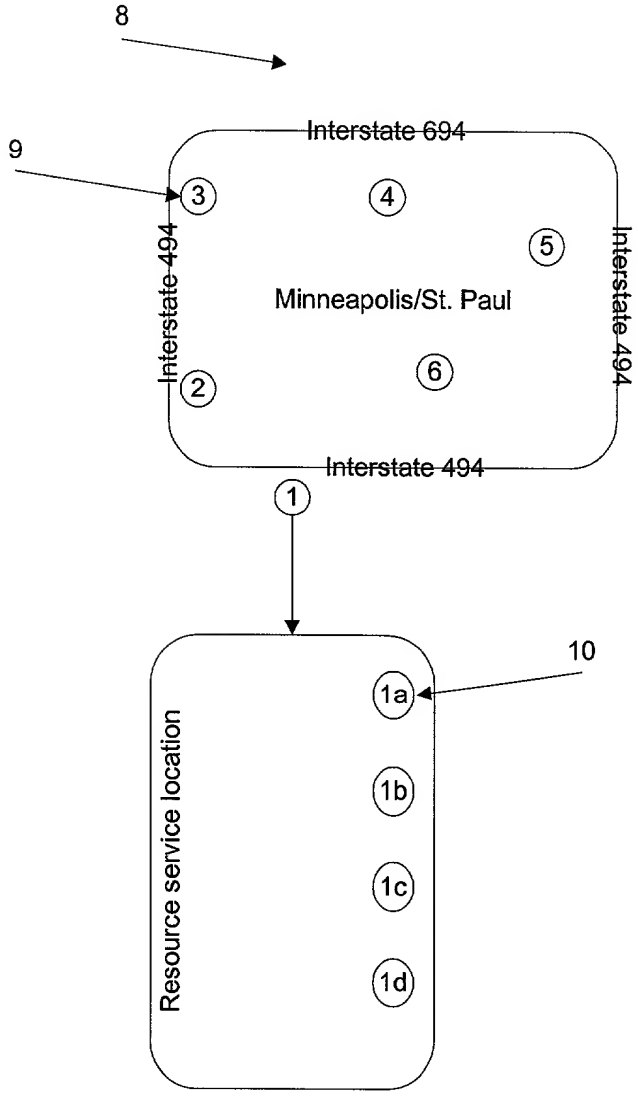

8
9
Interstate 694
3
4
5
Interstate 494
Minneapolis/St. Paul
Interstate 494
6
2
Interstate 494
1
10
1a
1b
1c
1d
Resource service location

Figure 2

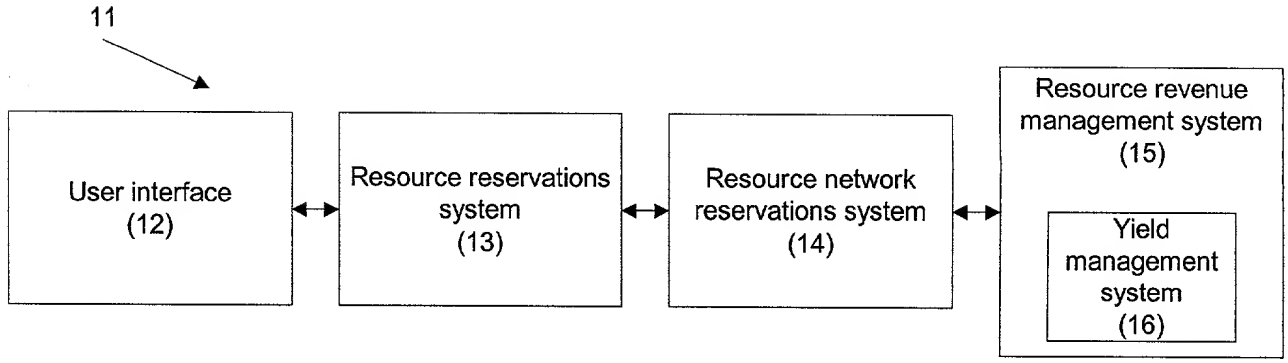


Figure 2A

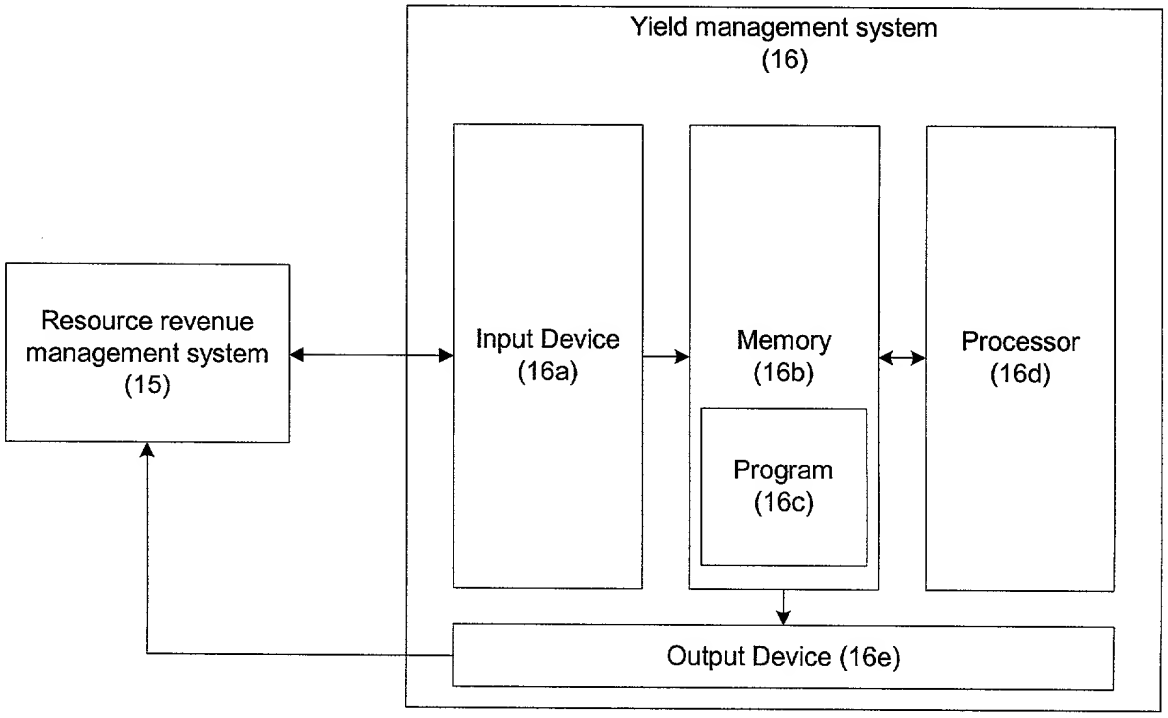


Figure 3

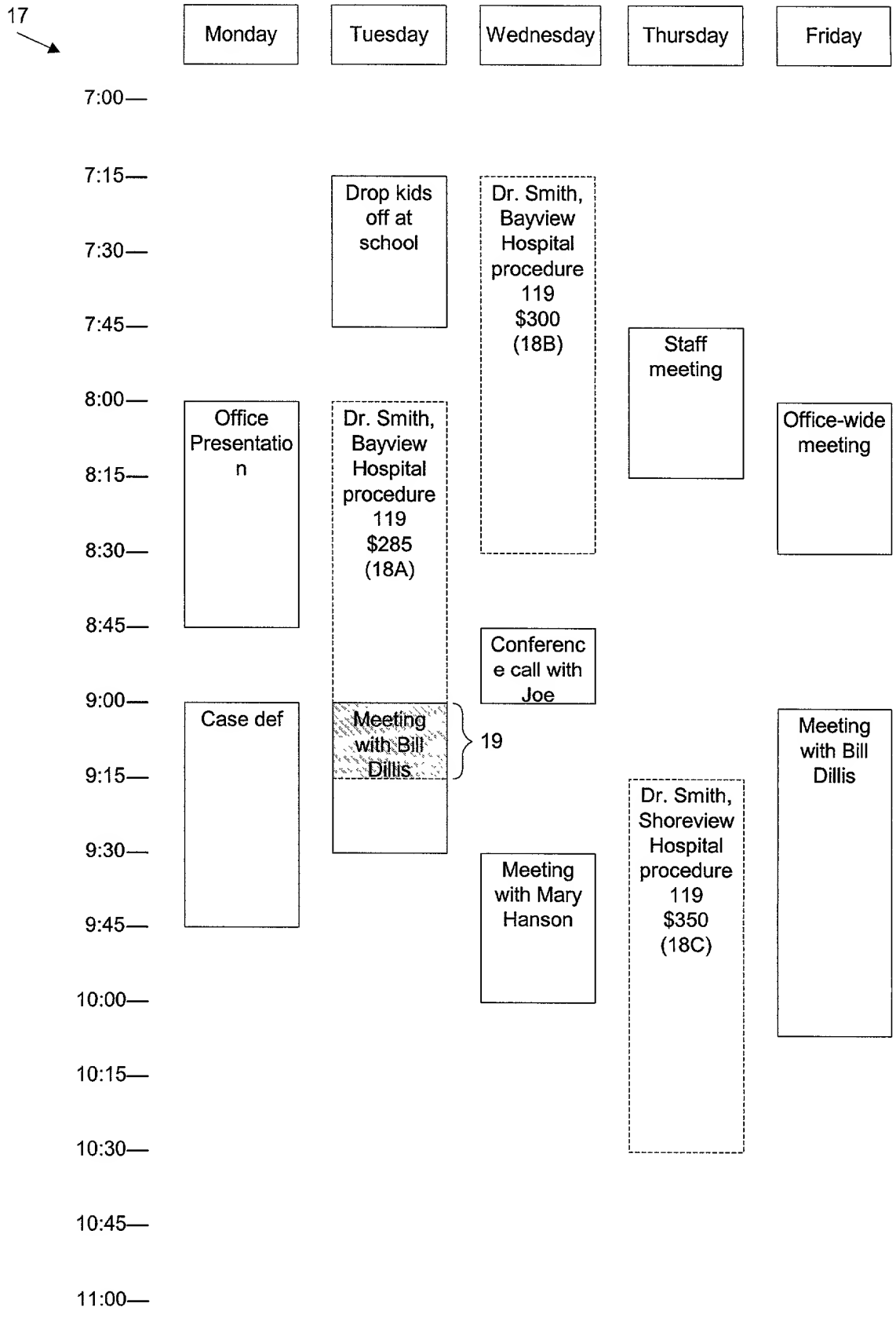

17
Monday
Tuesday
Wednesday
Thursday
Friday
7:00—
7:15—
7:30—
7:45—
8:00—
8:15—
8:30—
8:45—
9:00—
9:15—
9:30—
9:45—
10:00—
10:15—
10:30—
10:45—
11:00—
Drop kids off at school
Dr. Smith, Bayview Hospital procedure 119 $300 (18B)
Staff meeting
Office Presentatio n
Dr. Smith, Bayview Hospital procedure 119 $285 (18A)
Office-wide meeting
Conferenc e call with Joe
Case def
Meeting with Bill Dillis
19
Meeting with Bill Dillis
Dr. Smith, Shoreview Hospital procedure 119 $350 (18C)
Meeting with Mary Hanson

Figure 4

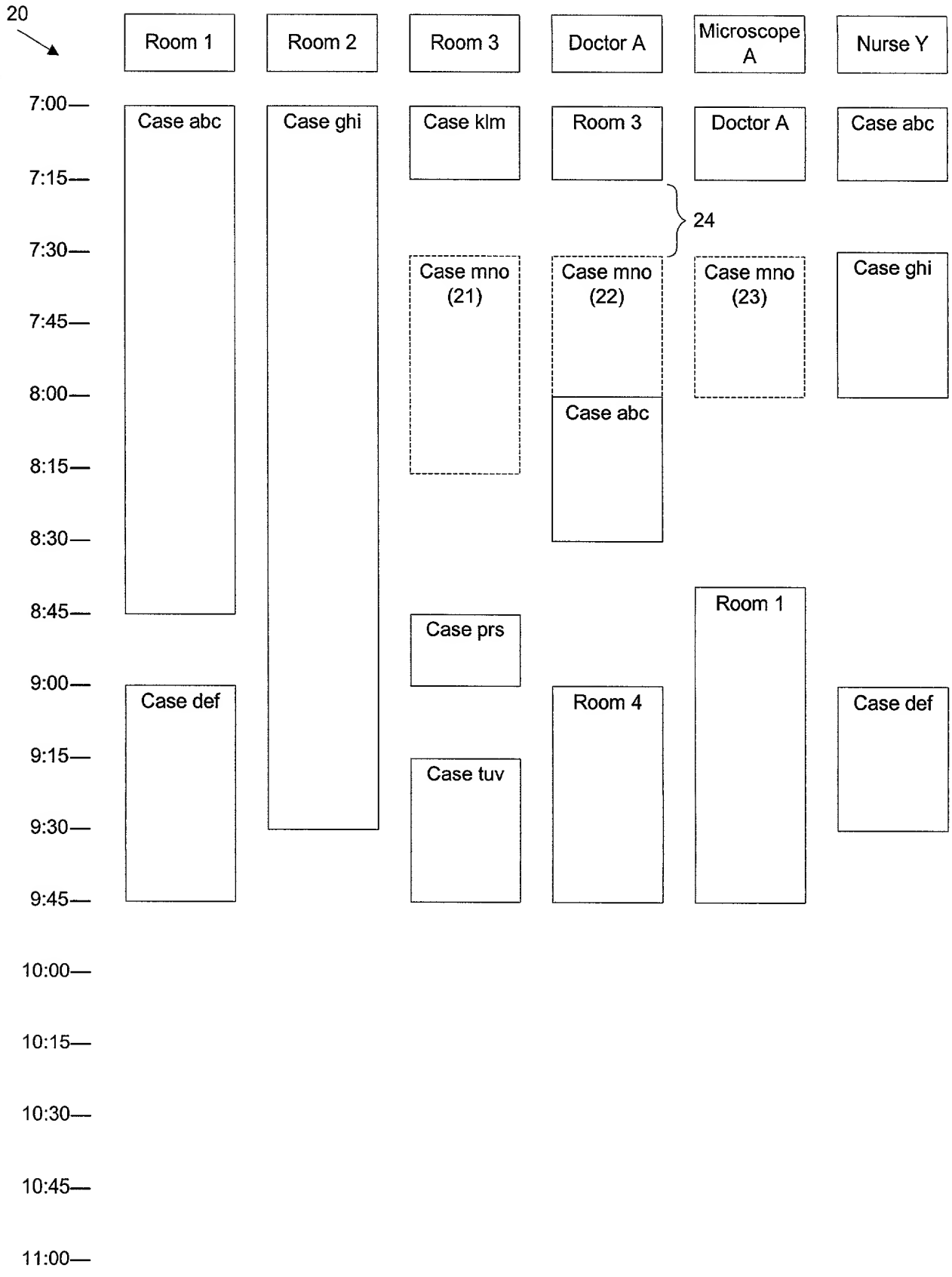

20
Room 1
Room 2
Room 3
Doctor A
Microscope A
Nurse Y
7:00
7:15
7:30
7:45
8:00
8:15
8:30
8:45
9:00
9:15
9:30
9:45
10:00
10:15
10:30
10:45
11:00
Case abc
Case ghi
Case klm
Room 3
Doctor A
Case abc
24
Case mno (21)
Case mno (22)
Case mno (23)
Case ghi
Case abc
Room 1
Case prs
Case def
Room 4
Case def
Case tuv

Figure 5

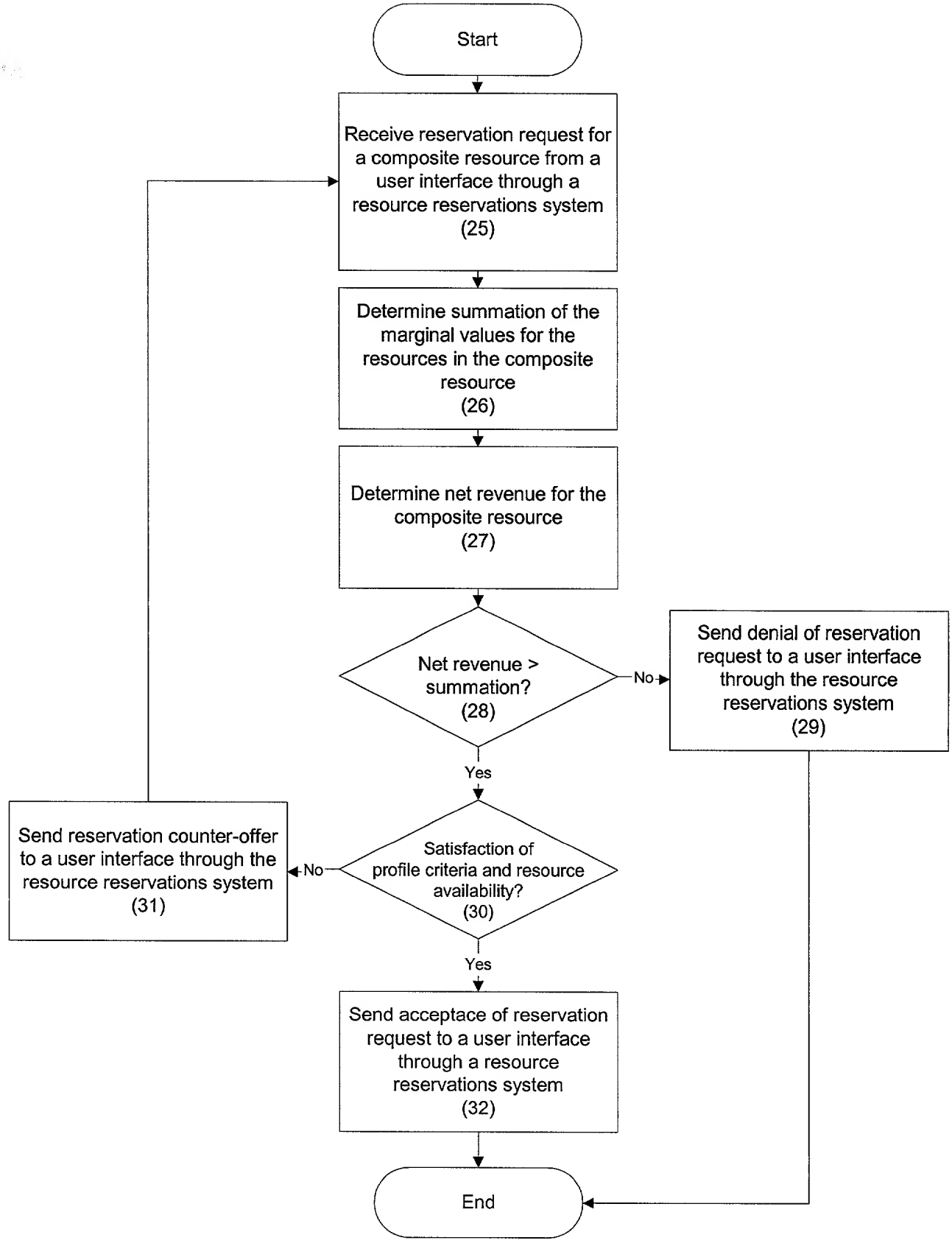

Start
Receive reservation request for a composite resource from a user interface through a resource reservations system (25)
Determine summation of the marginal values for the resources in the composite resource (26)
Determine net revenue for the composite resource (27)
Net revenue > summation? (28)
No
Send denial of reservation request to a user interface through the resource reservations system (29)
Yes
Satisfaction of profile criteria and resource availability? (30)
No
Send reservation counter-offer to a user interface through the resource reservations system (31)
Yes
Send acceptace of reservation request to a user interface through a resource reservations system (32)
End

Figure 6

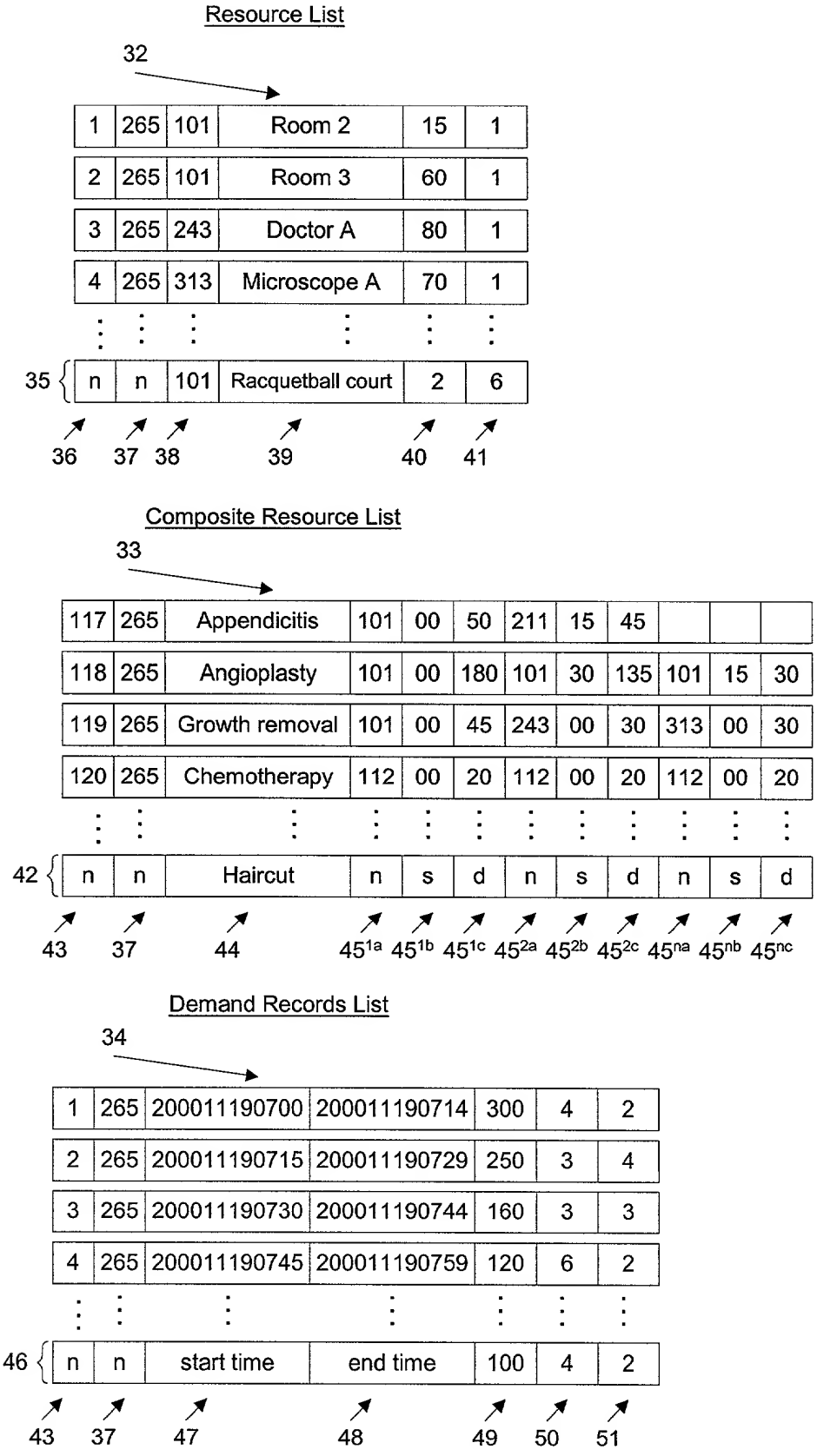

Resource List
32
1 265 101 Room 2 15 1
2 265 101 Room 3 60 1
3 265 243 Doctor A 80 1
4 265 313 Microscope A 70 1
35
n n 101 Racquetball court 2 6
36 37 38 39 40 41
Composite Resource List
33
117 265 Appendicitis 101 00 50 211 15 45
118 265 Angioplasty 101 00 180 101 30 135 101 15 30
119 265 Growth removal 101 00 45 243 00 30 313 00 30
120 265 Chemotherapy 112 00 20 112 00 20 112 00 20
42
n n Haircut n s d n s d n s d
43 37 44 45^1a 45^1b 45^1c 45^2a 45^2b 45^2c 45^na 45^nb 45^nc
Demand Records List
34
1 265 200011190700 200011190714 300 4 2
2 265 200011190715 200011190729 250 3 4
3 265 200011190730 200011190744 160 3 3
4 265 200011190745 200011190759 120 6 2
46
n n start time end time 100 4 2
43 37 47 48 49 50 51

Figure 7

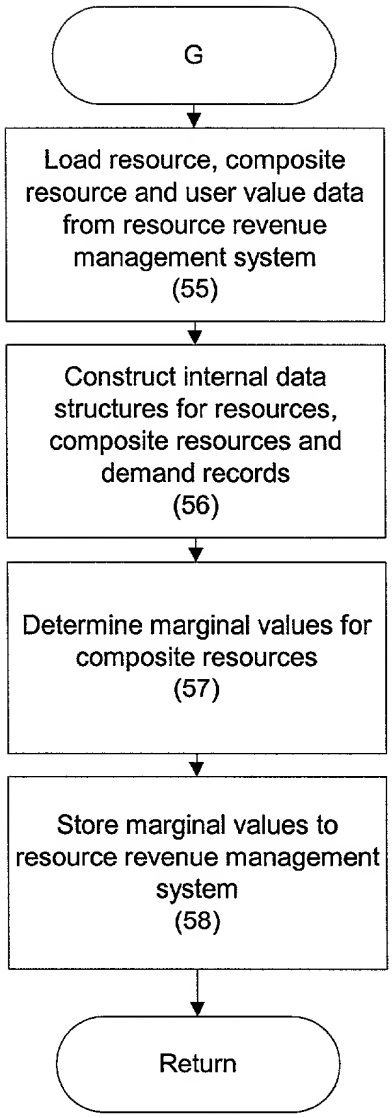

G
Load resource, composite resource and user value data from resource revenue management system (55)
Construct internal data structures for resources, composite resources and demand records (56)
Determine marginal values for composite resources (57)
Store marginal values to resource revenue management system (58)
Return

Figure 8

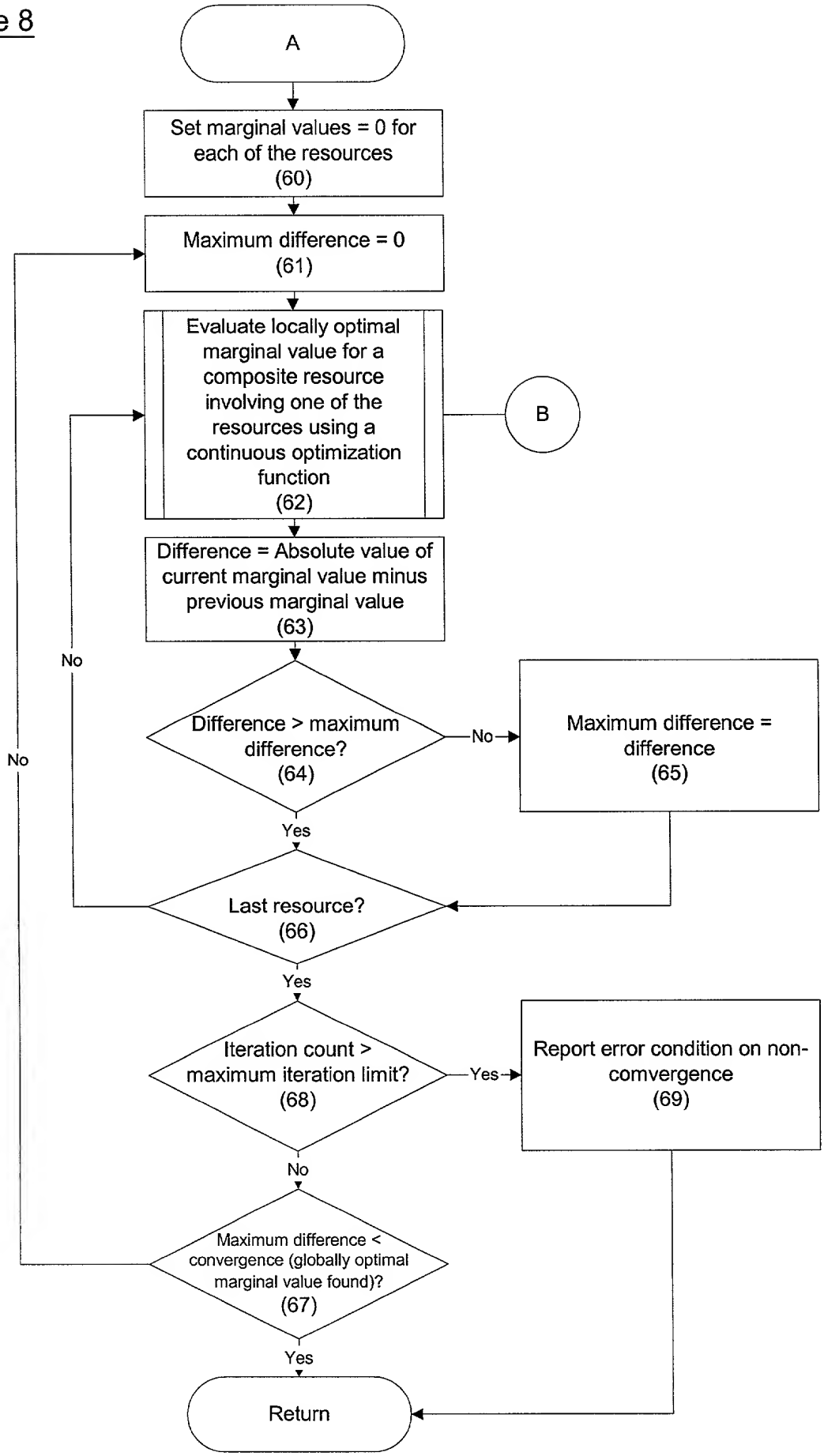

A
Set marginal values = 0 for each of the resources (60)
Maximum difference = 0 (61)
Evaluate locally optimal marginal value for a composite resource involving one of the resources using a continuous optimization function (62)
B
Difference = Absolute value of current marginal value minus previous marginal value (63)
Difference > maximum difference? (64)
No
Maximum difference = difference (65)
Yes
Last resource? (66)
No
Yes
Iteration count > maximum iteration limit? (68)
Yes
Report error condition on non-comvergence (69)
No
Maximum difference < convergence (globally optimal marginal value found)? (67)
No
Yes
Return

Figure 9

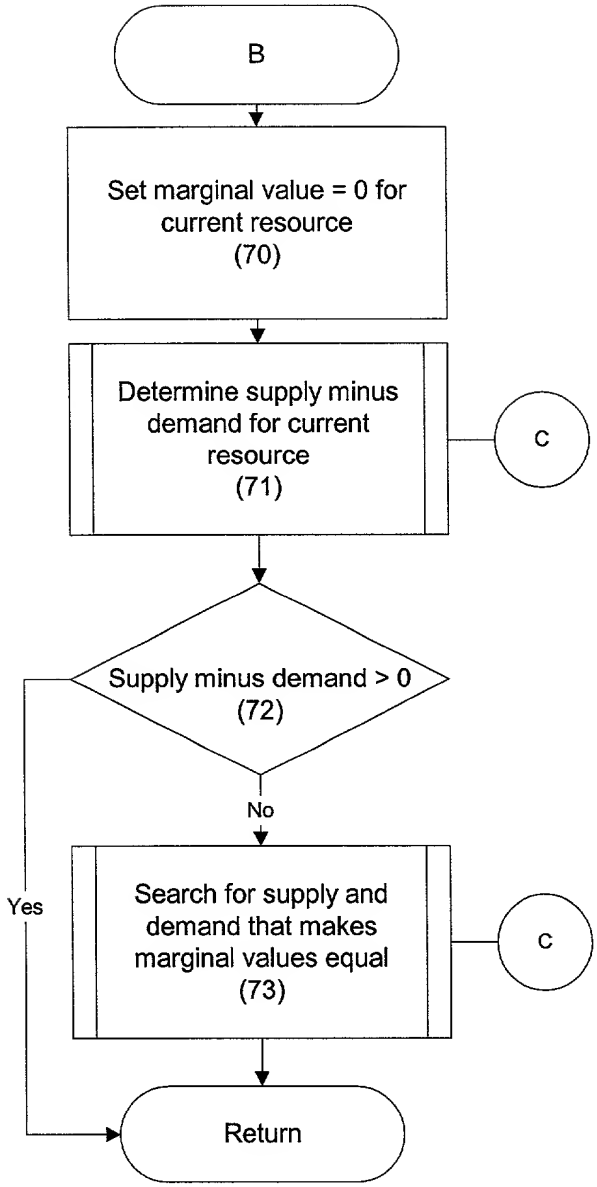

B
Set marginal value = 0 for current resource (70)
Determine supply minus demand for current resource (71)
C
Supply minus demand > 0 (72)
No
Yes
Search for supply and demand that makes marginal values equal (73)
C
Return

Figure 10A

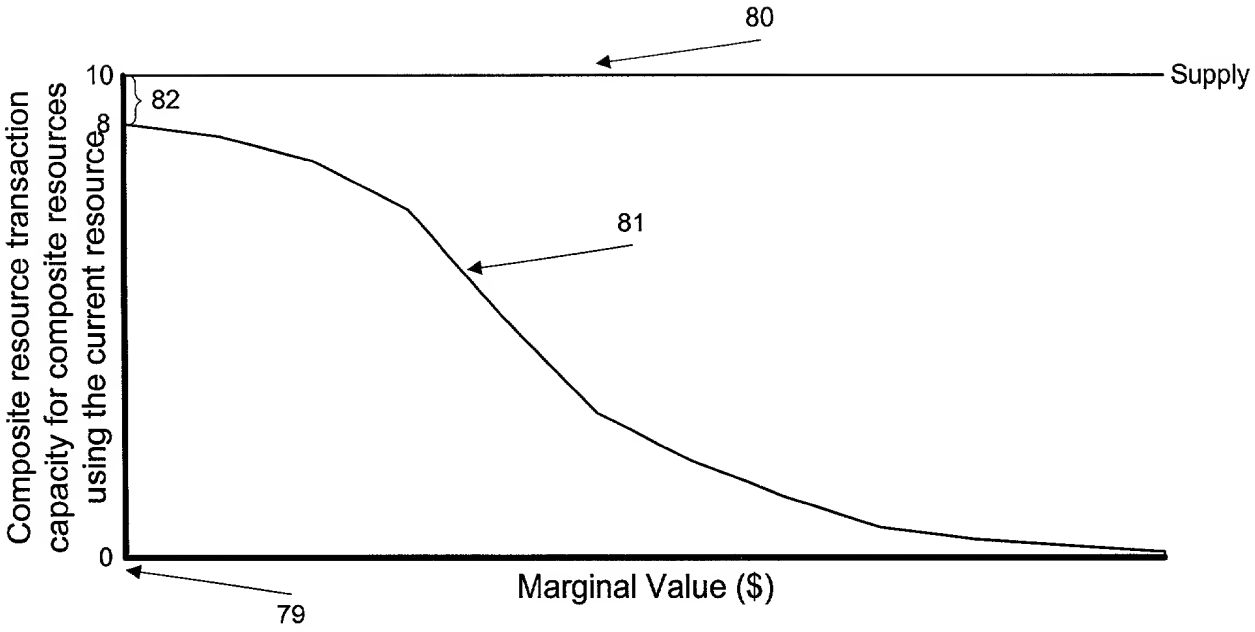

80
Supply
10
82
8
81
Composite resource transaction capacity for composite resources using the current resource
0
79
Marginal Value ($)

Figure 10B

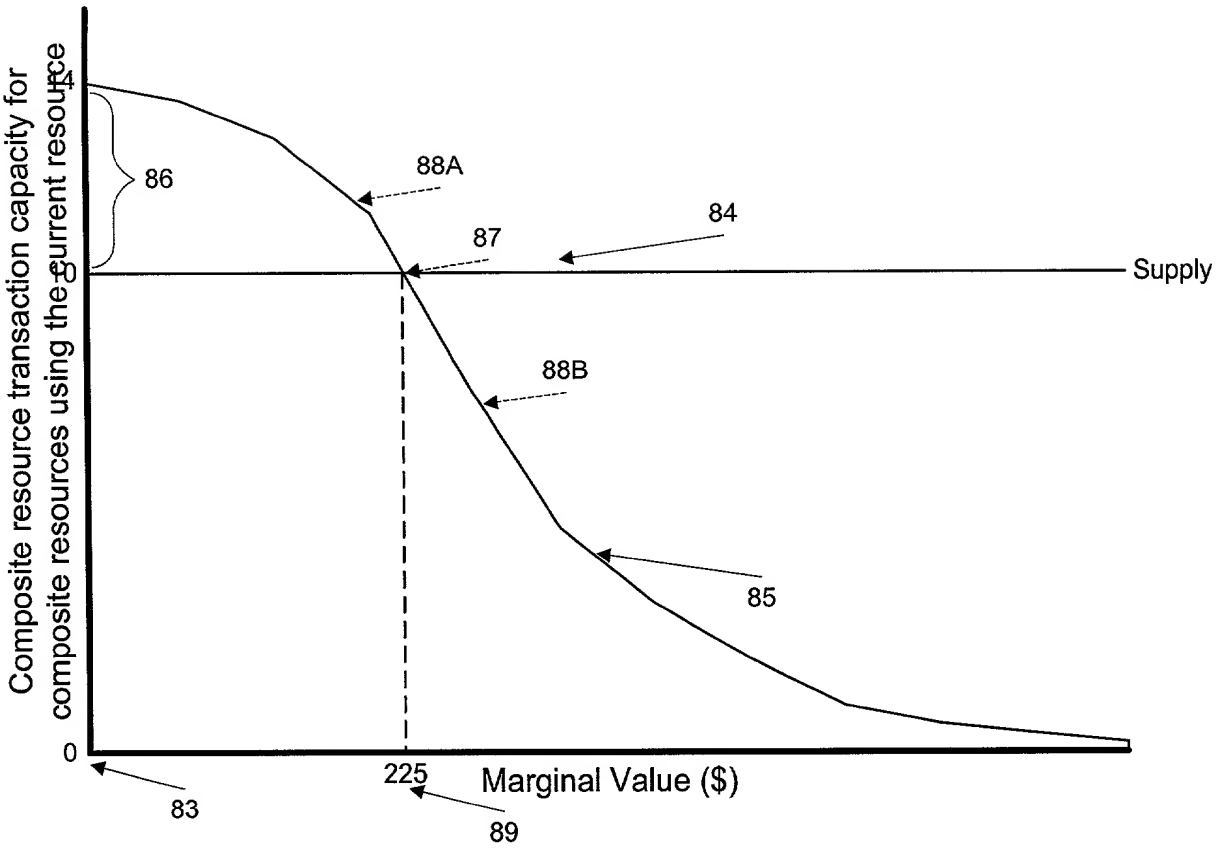

Composite resource transaction capacity for composite resources using the current resource
1
0
86
88A
87
84
Supply
88B
85
225
Marginal Value ($)
83
89

Figure 11

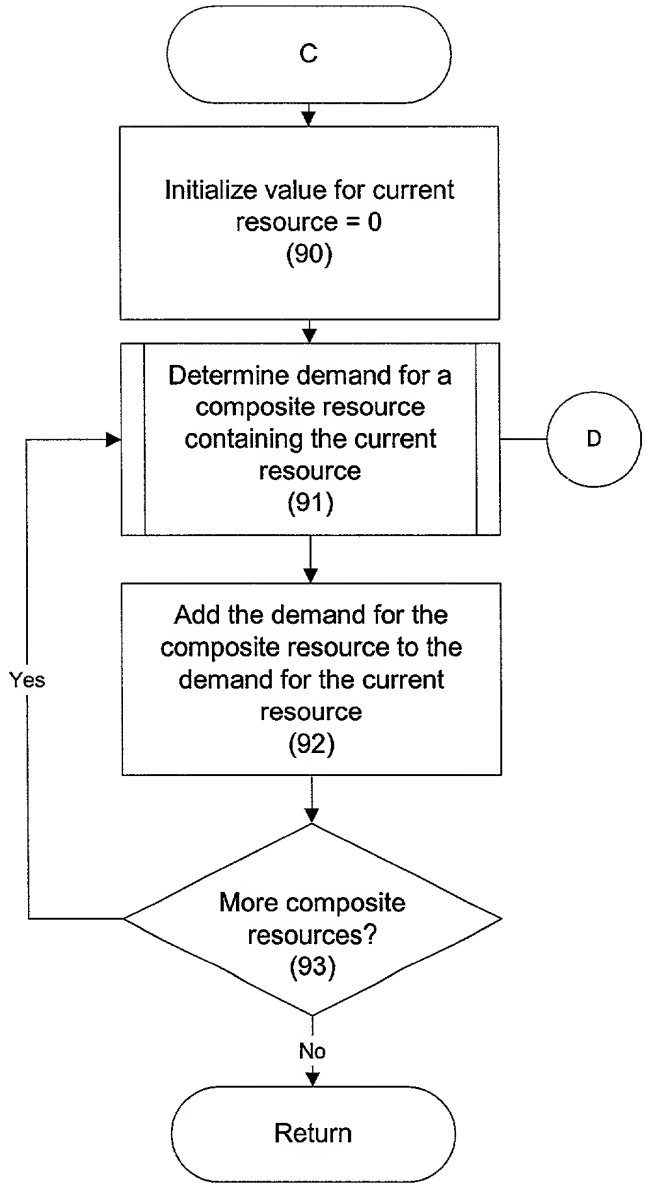

C
Initialize value for current resource = 0
(90)
Determine demand for a composite resource containing the current resource
(91)
D
Add the demand for the composite resource to the demand for the current resource
(92)
Yes
More composite resources?
(93)
No
Return

Figure 12

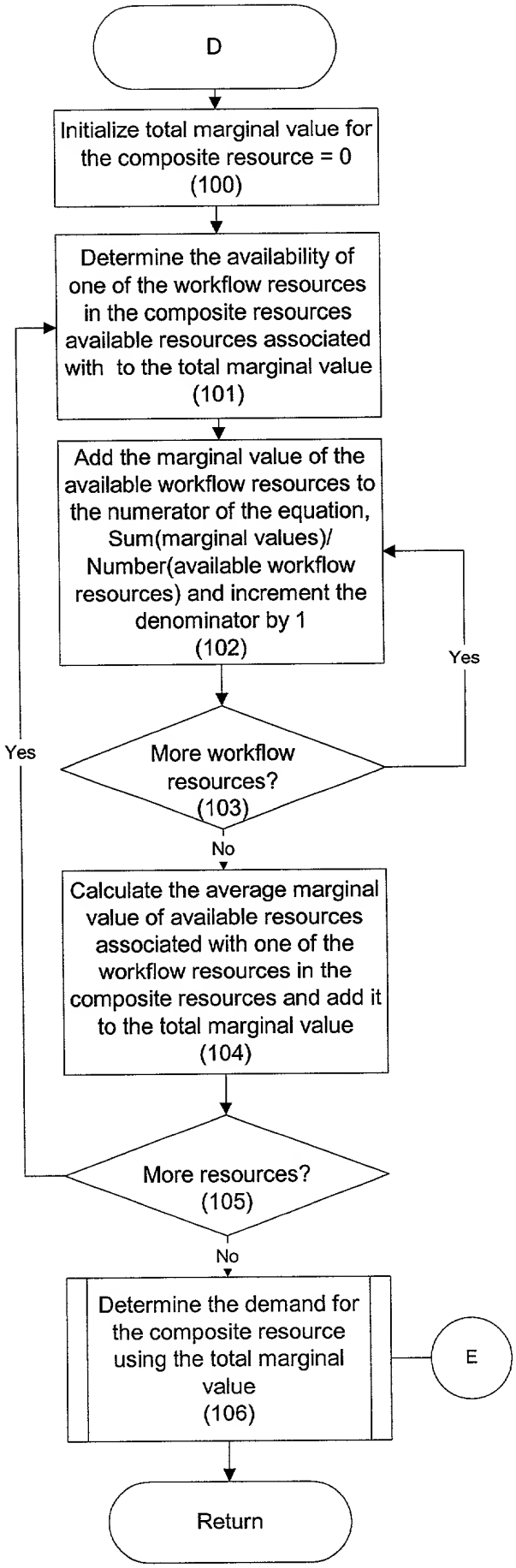

D
Initialize total marginal value for the composite resource = 0 (100)
Determine the availability of one of the workflow resources in the composite resources available resources associated with to the total marginal value (101)
Add the marginal value of the available workflow resources to the numerator of the equation, Sum(marginal values)/ Number(available workflow resources) and increment the denominator by 1 (102)
Yes
More workflow resources? (103)
Yes
No
Calculate the average marginal value of available resources associated with one of the workflow resources in the composite resources and add it to the total marginal value (104)
More resources? (105)
No
Determine the demand for the composite resource using the total marginal value (106)
E
Return

Figure 13

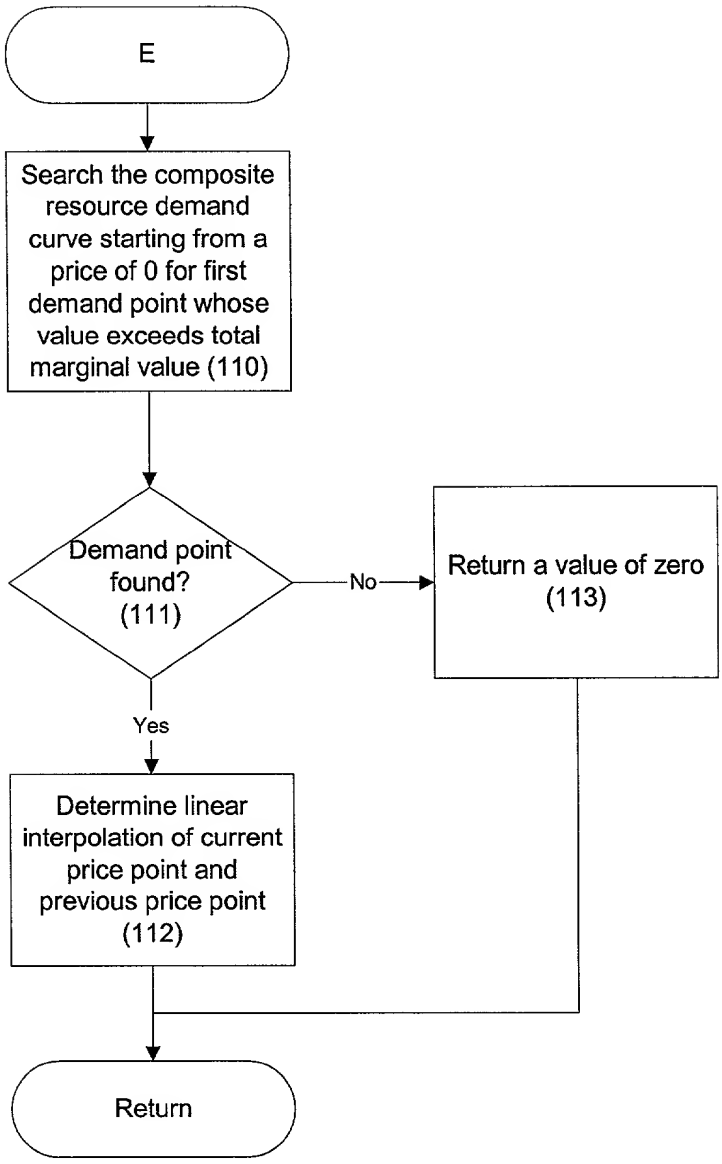

E
Search the composite resource demand curve starting from a price of 0 for first demand point whose value exceeds total marginal value (110)
Demand point found? (111)
No
Return a value of zero (113)
Yes
Determine linear interpolation of current price point and previous price point (112)
Return

Figure 14A

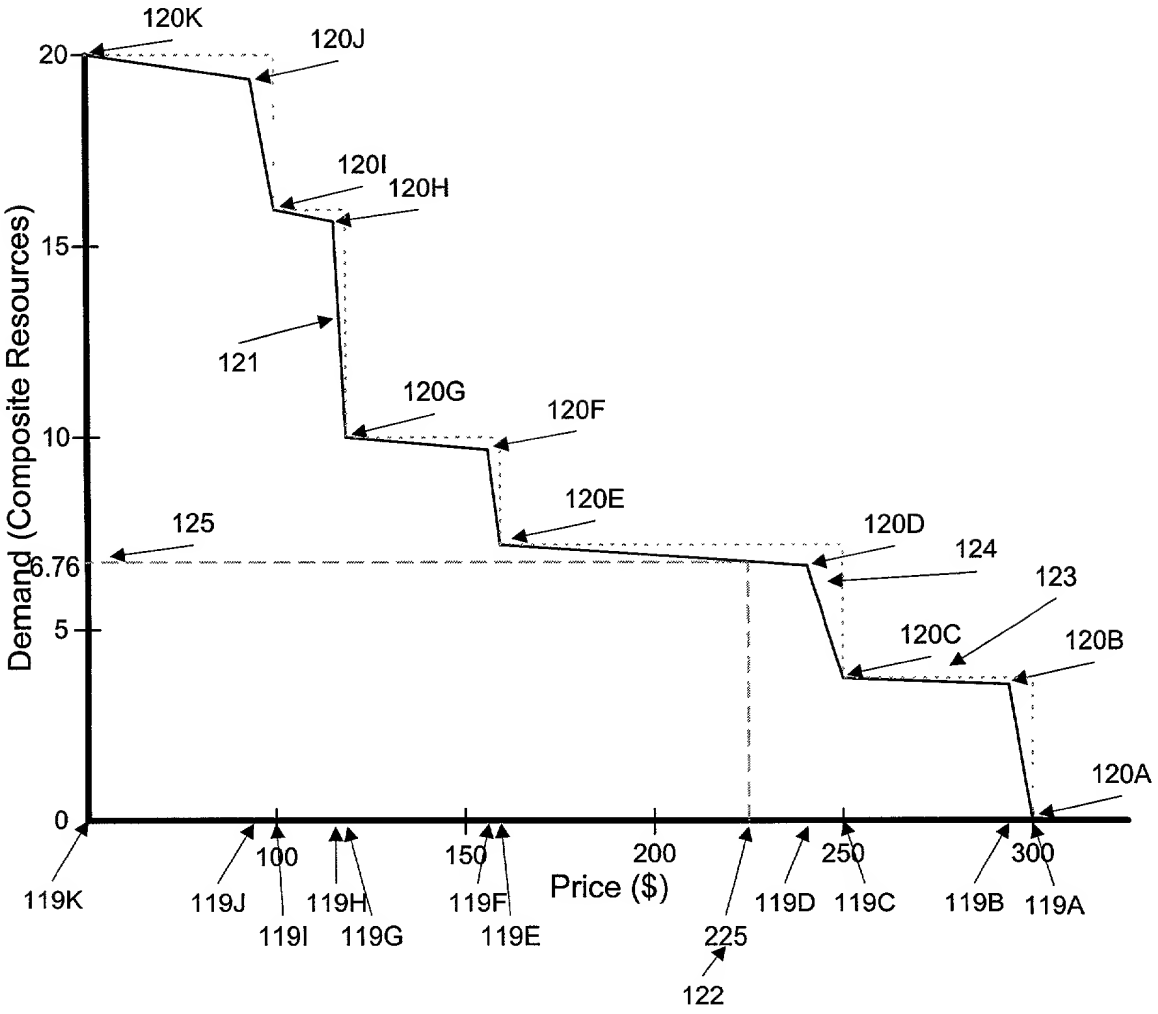

120K
120J
120I
120H
121
120G
120F
120E
120D
124
123
120C
120B
120A
125
Demand (Composite Resources)
20
15
10
6.76
5
0
100
150
200
225
250
300
Price ($)
119K
119J
119I
119H
119G
119F
119E
122
119D
119C
119B
119A

Figure 14B

Composite Resource
Demand Curve Points

	Price	Demand
120A	300	0.0
120B	295	3.6
120C	250	4.0
120D	241	6.7
120E	160	7.0
120F	156	9.7
120G	120	10.0
120H	118	15.4
120I	100	16.0
120J	90	19.6
120K	0	20.0

Figure 15

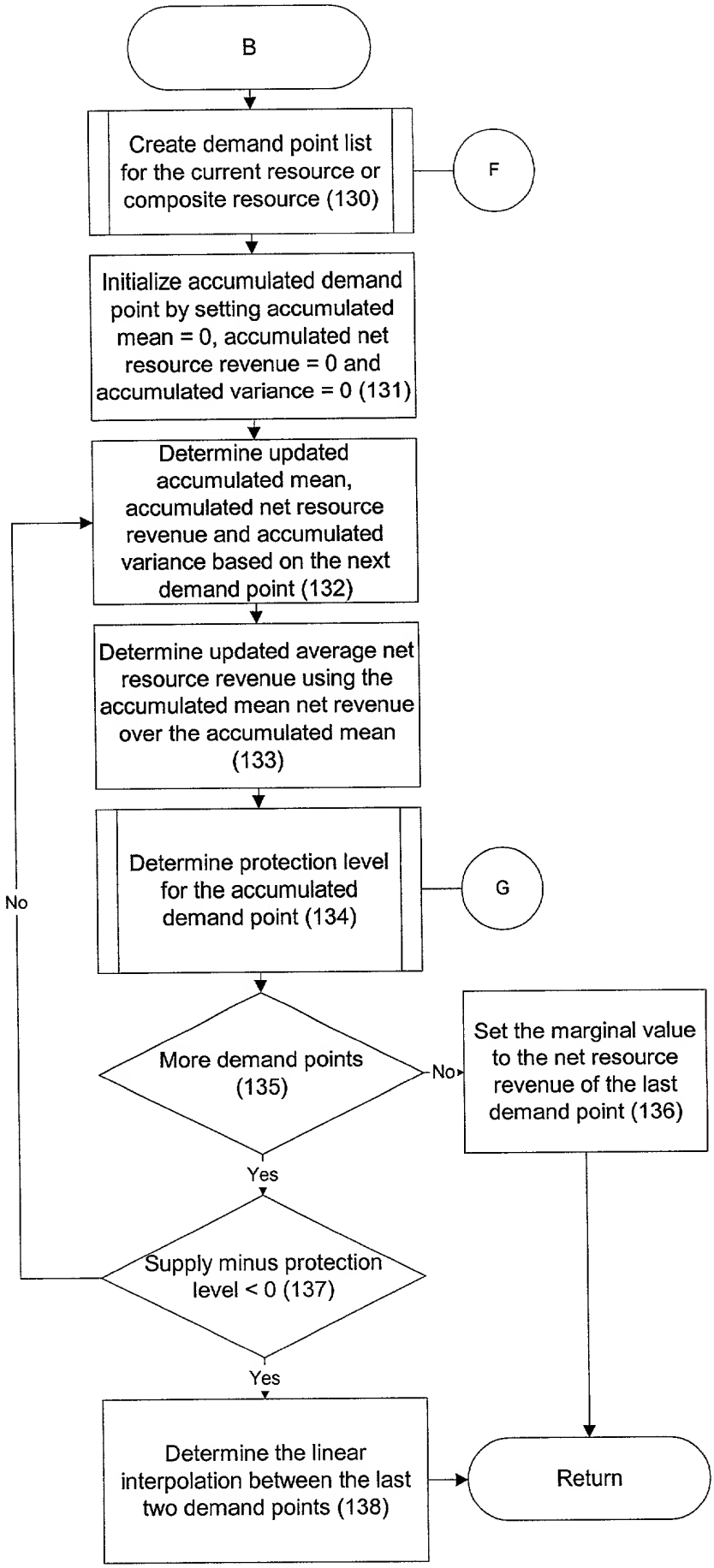

B
Create demand point list for the current resource or composite resource (130)
F
Initialize accumulated demand point by setting accumulated mean = 0, accumulated net resource revenue = 0 and accumulated variance = 0 (131)
Determine updated accumulated mean, accumulated net resource revenue and accumulated variance based on the next demand point (132)
Determine updated average net resource revenue using the accumulated mean net revenue over the accumulated mean (133)
Determine protection level for the accumulated demand point (134)
G
No
More demand points (135)
No
Set the marginal value to the net resource revenue of the last demand point (136)
Yes
Supply minus protection level < 0 (137)
Yes
Determine the linear interpolation between the last two demand points (138)
Return

Figure 16

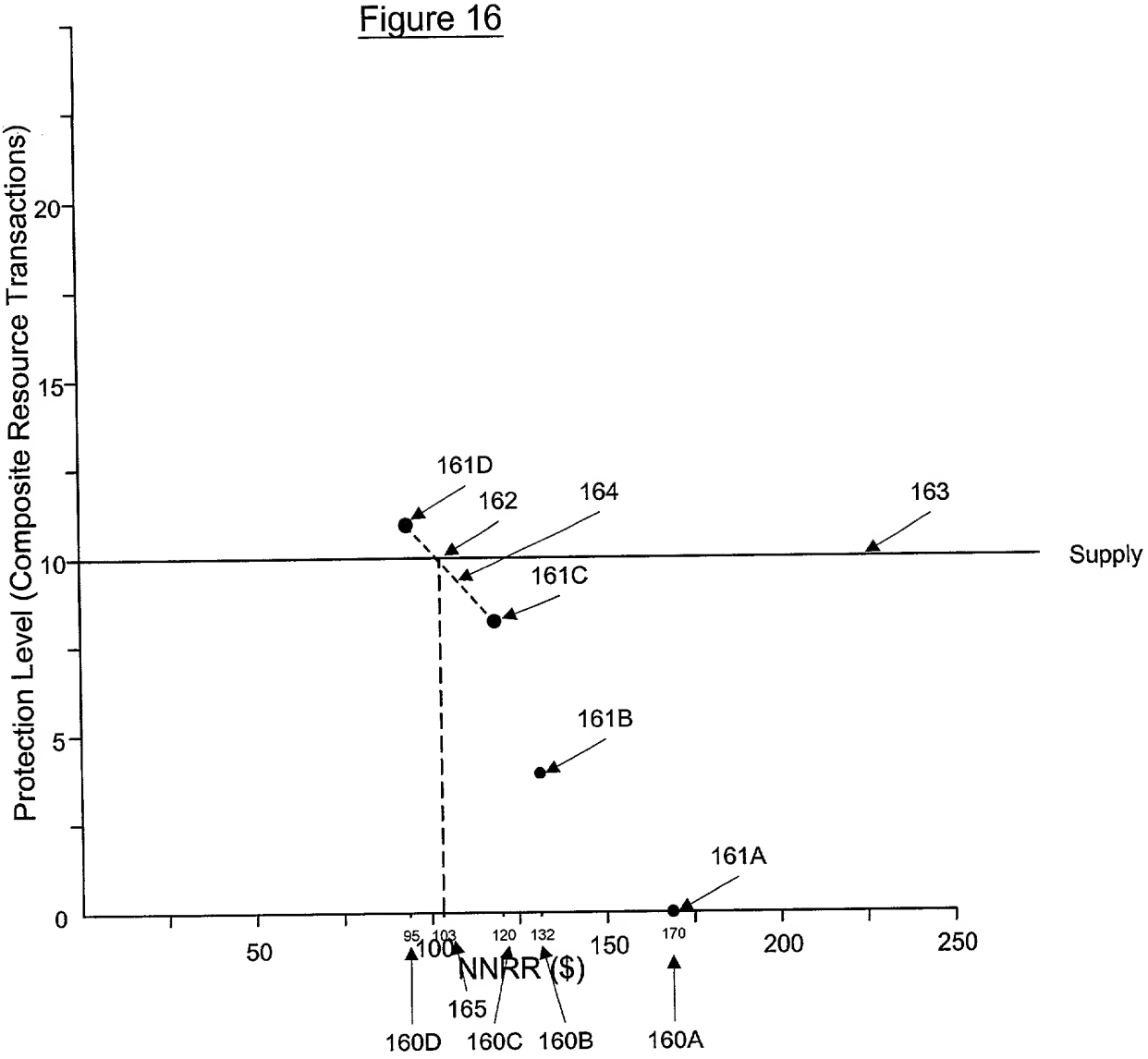

Protection Level (Composite Resource Transactions)
20
15
10
5
0
161D
162
164
163
Supply
161C
161B
161A
50
95
100
103
120
132
150
170
200
250
NNRR ($)
165
160D
160C
160B
160A

Figure 17A

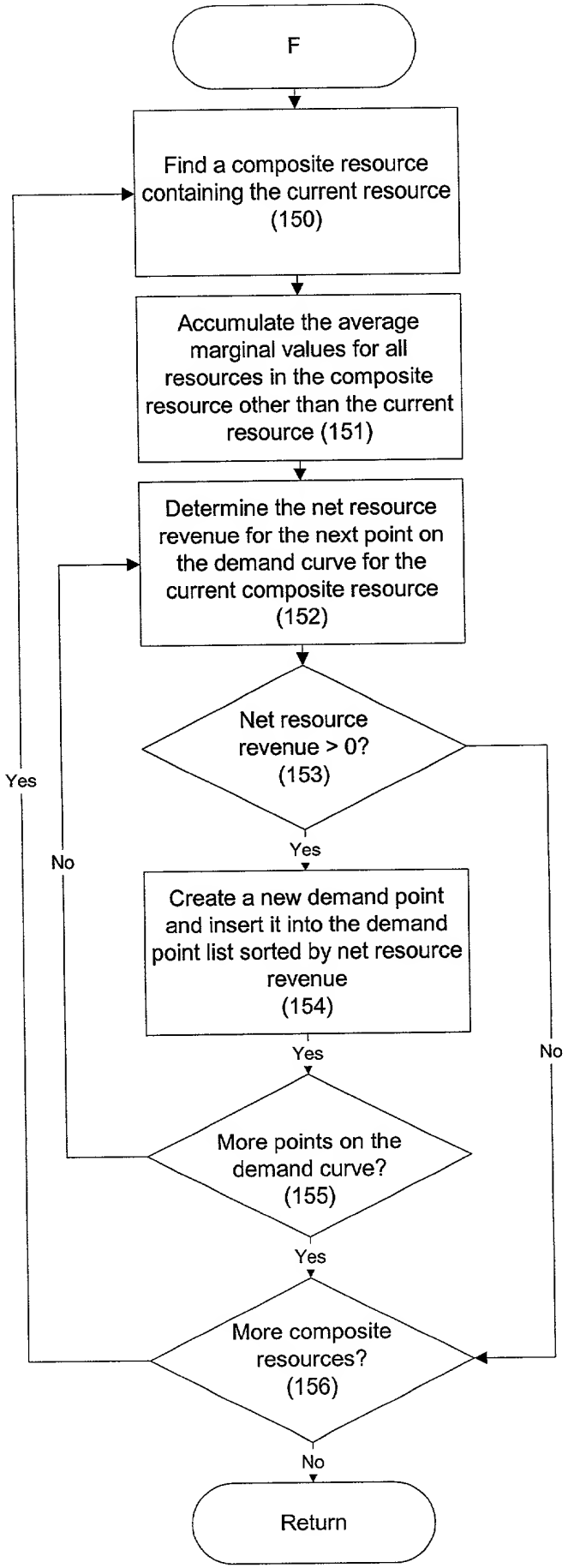

F
Find a composite resource containing the current resource (150)
Accumulate the average marginal values for all resources in the composite resource other than the current resource (151)
Determine the net resource revenue for the next point on the demand curve for the current composite resource (152)
Net resource revenue > 0? (153)
Yes
No
Create a new demand point and insert it into the demand point list sorted by net resource revenue (154)
Yes
No
More points on the demand curve? (155)
Yes
No
More composite resources? (156)
Yes
No
Return

Figure 17B

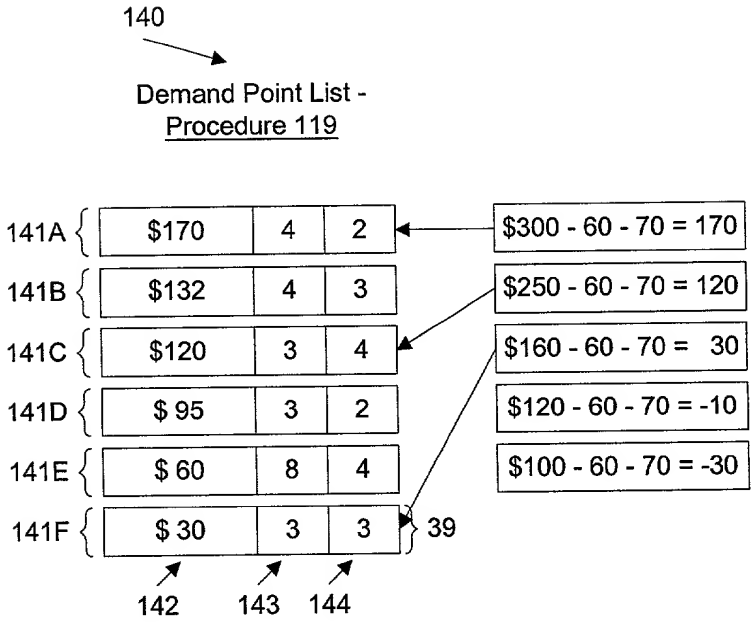

140
Demand Point List -
Procedure 119
141A
$170
4
2
$300 - 60 - 70 = 170
141B
$132
4
3
$250 - 60 - 70 = 120
141C
$120
3
4
$160 - 60 - 70 = 30
141D
$ 95
3
2
$120 - 60 - 70 = -10
141E
$ 60
8
4
$100 - 60 - 70 = -30
141F
$ 30
3
3
39
142
143
144

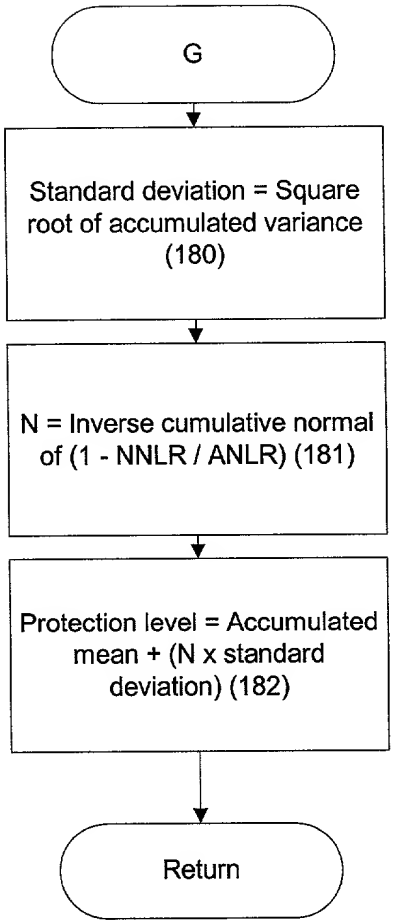
Figure 17C

140

Sample Calculation

151A	0	0	0	0	0	170
151B	4	680	2	170	5	132
151C	8	1208	5	151	9	120
151D	11	1568	9	143	13	95
	152	153	154	155	156	157

Figure 18


G
Standard deviation = Square root of accumulated variance (180)
N = Inverse cumulative normal of (1 - NNLR / ANLR) (181)
Protection level = Accumulated mean + (N x standard deviation) (182)
Return